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CLAIMS

What is claimed is:

1. A method of quantifying the degree of fusion of a layer comprising the following steps with no specified order, unless order is implicit in the step itself:
 - (a) reflecting a laser beam off the exposed surface of the layer to produce a reflected laser beam;
 - 5 (b) acquiring the reflected laser beam with a sensor and determining the value of a characteristic of the reflected laser beam;
 - (c) determining a value based on the characteristic of the reflected beam that correlates to degree of fusion of the layer; and
 - (d) correlating the value based on the characteristic of the reflected beam to
10 the degree of fusion of the layer.
2. The method of quantifying the degree of fusion of the layer of claim 1, further comprising the step (e) of determining the value of the characteristic of the laser beam reflecting the laser beam off the exposed surface of the layer having a known degree of fusion;
- 5 wherein the value based on the characteristic of the reflected beam that correlates to degree of fusion of the layer of step (c) is the value of the characteristic of the acquired reflected beam of step (b); and
- wherein the step of correlating the value based on the characteristic of the reflected beam to the degree of fusion of the layer of step (d) comprises comparing:

10 the value based on the characteristic of the reflected beam
of step (c) and
the value of the characteristic of the laser beam being
reflected off the exposed surface of the layer having a known
degree of fusion of step (f).

15 3. The method of quantifying the degree of fusion of the layer of claim 1,
further comprising the step (f) of determining the value of the characteristic of the
laser beam being reflected off the exposed surface of a plurality of layers having
different known degrees of fusion, and plotting a graph of the known degree of fusion
versus the value of the characteristic of the laser beam being reflected off the exposed
20 surface of the layer having different known degree of fusion;
wherein the value based on the characteristic of the reflected beam that
correlates to degree of fusion of the layer of step (c) is the value of the characteristic
of the acquired reflected beam of step (b); and
wherein the step of correlating the value based on the characteristic of the
25 reflected beam to the degree of fusion of the layer of step (d) comprises entering the
graph with the value based on the characteristic of the reflected beam of step (c) and
determining the degree of fusion of the layer.

4. The method of quantifying the degree of fusion of the layer of claim 1,
wherein the characteristic of the reflected laser beam of step (b) is the wavefront of
the laser beam.

5. The method of quantifying the degree of fusion of the layer of claim 4, wherein step (d) comprises correlating the wavefront distortion to the degree of fusion of the layer.

6. The method of quantifying the degree of fusion of the layer of claim 1, wherein the characteristic of the reflected laser beam of step (b) is an intensity profile characteristic of the reflected laser beam.

7. The method of quantifying the degree of fusion of the layer of claim 6, wherein the intensity profile characteristic of the reflected laser beam is the total intensity of the reflected laser beam.

8. The method of quantifying the degree of fusion of the layer of claim 1, wherein step (d) comprises comparing the value of the characteristic of the reflected laser beam of step (b) to a set of characteristic values corresponding to a known set of fusion values.

9. The method of quantifying the degree of fusion of the layer of claim 1, wherein the layer is transparent.

10. The method of quantifying the degree of fusion of the layer of claim 1, wherein the layer is translucent or opaque.

11. The method of quantifying the degree of fusion of the layer of claim 1, wherein the method is continuous.

12. The method of quantifying the degree of fusion of the layer of claim 1, wherein the layer is a polymeric material overlying a substrate.

13. The method of quantifying the degree of fusion of the layer of claim 12, wherein the layer is transparent or translucent.

14. The method of quantifying the degree of fusion of the layer of claim 13, wherein the substrate comprises a printed pattern and an edge portion that is free of the printed pattern, and wherein the laser beam is reflected off the edge portion.

15. The method of quantifying the degree of fusion of the layer of claim 13, wherein the method is continuous.

16. An apparatus for quantifying the degree of fusion of a layer
30 comprising:
a laser generator for projecting an initial laser beam unto the layer;
a sensor for receiving a laser beam reflected off the layer; and
a computer operatively connected to the sensor for determining the degree of fusion of the layer.

17. The apparatus for quantifying the degree of fusion of the layer of claim 16, wherein the sensor is a wavefront-sensitive sensor.

18. The apparatus for quantifying the degree of fusion of the layer of claim 17, further comprising a beam expander operatively placed between the wavefront-sensitive sensor and the layer.

19. The apparatus for quantifying the degree of fusion of the layer of claim 16, wherein the sensor is an intensity profile sensitive sensor.

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20. A method of controlling the degree of fusion of a polymer layer comprising:
reflecting a laser beam off the polymer layer to produce a reflected laser beam;
acquiring the reflected laser beam and determining the value of a characteristic
40 of the reflected laser beam;
comparing the value of the determined reflected characteristic with a value corresponding to the target minimum fusion; and
adjusting the fusion processing conditions.

21. The method of claim 20, wherein the value of the target minimum
45 fusion is determined by the steps comprising:
preparing a series of layer samples that have been fused at various temperature conditions;

determining the value of the reflected characteristics of the film samples by
reflecting a laser beam off the samples to produce a reflected laser beam and
50 determining the value of the characteristic of the reflected laser beam;
selecting a minimum desired degree of fusion of the film samples; and
selecting the corresponding reflected characteristic as a minimum target value.

22. The method of claim 21, wherein the layer comprises a polyvinyl
chloride plastisol.

23. The method of claim 20, wherein the laser beam is reflected off the surface of the
polymer layer near the edge of the polymer layer.